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(54) A DRY FORMING SYSTEM FOR FIBER PRODUCTS.

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Description

The present invention relates to a dry forming system for successively laying out a layer of fibers on a moved forming wire, the system being of the kind which comprises a pipe of a perforated classification material and means for establishing through this pipe and through a return pipe system a circulating flow of an air fluidized fiber material, which is caused to be successively discharged through the perforations of the pipe, and means for sucking air down through the forming wire such that the perforated pipe as located above the wire is placed generally in a downwardly directed air flow, by which the fibers discharged through the perforations of the pipe are carried downwardly for delivery onto the forming wire; inside the pipe is arranged a needle cylinder rotating about an axis, which is parallel with the axis of the pipe, but preferably located underneath this axis, such that the needles of the cylinder sweep across a longitudinal, internal area of the perforated pipe at a small distance from the inner surface of the pipe.

A system of this kind is disclosed in WO 81/02031. The needle cylinder serves, for one thing, to agitate the fibers just inside the area, in which the fibres are discharged at a maximum rate, viz. along the bottom area of the perforated pipe, such that lump formations in the fibers will be counteracted, just as the fibers, by the associated vivid reorganizing thereof, will more easily get discharged through the pipe wall with a reasonably high capacity.

For the dry forming of paper products it is customary to make use of a fiber material consisting of rather short cellulose fibers, having a length of some 2—5 mm, but even with the use of perforations having a corresponding diameter it has been found that also longer fibers, e.g. plastic fibers of a length of 15—20 mm, may get discharged through these perforations, when the fibers are violently agitated.

However, the thought has come up that the discharge capacity as far as long fibers are concerned could be further raised with the use of perforations which are equally long or even longer, when the width of the perforations is kept small enough to still make the pipe wall able to withhold lump formations from being discharged. For a closer consideration of this possibility it is essential that the general flow-through velocity of the fiber material in and along the pipe is relatively low, viz. of the magnitude 2—4 m/sec, while the peripheral tip velocity of the transversely rotating needle cylinder is desired to be relatively high, viz. of a magnitude some 10 times as high. Hereby the needle cylinder will act as a carding cylinder, which will seek to orient the long fibres mainly in the moving direction of the needles, i.e. in the cross direction of the perforated pipe. It will be conditioned hereby that the oblong perforations in the pipe wall should be oriented in the circumferential direction of the pipe for obtaining a high discharge capacity of the "cross carded" fibers, but experiments have shown that this measure does not provide for any considerable increase or any increase at all of the discharge capacity.

It has been found with great surprise, on the other hand, that an essential increase of the discharge capacity is obtainable with the use of oblong perforations, which are oriented lengthwise of the perforated pipe, i.e. just crosswise of the direction which should be selected based on the above theoretical consideration. For the present it is impossible to explain this effect, but the practical result is remarkable inasfar as the discharge capacity is more than doubled when the oblong perforations are oriented in the length direction of the pipe.

Thus, the invention is primarily characterized in that the pipe wall is provided with oblong protrusions and that these are oriented in the length direction of the tube.

With the use of oblong perforations having an effective orientation it is thus possible to achieve a considerable discharge capacity for long fibers, whereby it becomes attractive to produce dry-formed long fiber products of a high quality and evenness, because the pipe wall will still constitute a classification element which will sort off fiber lumps from the laid out material, whereby the latter may be even and uniform, also when made with a small thickness. It will be possible, thus, to make use of fiber materials other than cellulose, whereby new and attractive products may be manufactured for different purposes, or at least such products may be produced at considerably reduced costs due to the remarkably increased discharge capacity of the dry forming system as far as long fibers are concerned.

It will be appreciated that the use of the oblong perforations will not in any way involve any restriction of the discharge capacity for such short cellulose fibers which might be present in the fiber material. Such short fibers, whether being used alone or in admixture with longer fibers, may easily be discharged through the oblong perforations, which — due to their small width — will still be "classifying" also as far as the short fibers are concerned.

There are two important consequences of this, viz. both that a given standard pipe having axially elongated perforations will be usable for a classified laying out or down of materials of short as well as long fibers, i.e. the pipe may be standardized irrespective of which kinds of fibers it should handle, and that such a pipe may work with a fiber material containing both short and long fibers, e.g. both cellulose and plastic fibers. It is possible to hereby build up some special products, which may show special characteristics when subjected to some suitable after-treatment, e.g. showing a good porosity and therewith a good hygroscopic effect due to the cellulose fibers, combined with a good mechanical strength resulting from spotwise bindings between the long plastic fibers, which, in the areas between these binding spots, will act to mechanically hold the shorter cellulose fibers.

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Thus, the use of the oblong perforations will promote the possibilities of exploiting fiber materials, which hold fibers of different length and characters, for the production of webs of particular characteristics. On this background it is a special feature of the invention that such a web material may be provided by a mixing together of different kinds of fibers, which are delivered from individual defibration devices for respective short- and long-fibered pulp materials. It is hereby important that a cellulose pulp material may be worked into short fibers e.g. in a hammer mill, while a pulp material consisting of long plastic fibers are move suitably defibrated in a special tearing-up unit, which separates the fibers without breaking them into smaller pieces.

Both the short and the long fibers, therefore, may be brought into an air fluidized condition by separation in an optimized manner from respective pulp materials, and thereafter it will be sufficient to move the fluidized fibers together and intermix them not later than by their admission into the perforated pipe. In practice it is preferred to bring the air flows holding the respective short and long fibers from the respective defibrators together in a mixing unit prior to their admission into the perforated tube, because it will be secured hereby that the mixing of the fibers will be carried out effectively already before the fibers enter the perforated pipe, thereby enhancing the uniformity of the fiber material layer laid out on the forming wire.

In the following the invention is described in more detail with reference to the drawing, in which:

Fig. 1 is a perspective view of a known dry forming system,

Fig. 2 is a cross section thereof,

Fig. 3 is a longitudinal sectional view of a corresponding system according to the invention, and

Fig. 4 is a schematic diagram of further details.

In Fig. 1 is shown a foraminous forming wire 2, which in a closed path has a horizontal run through a forming unit 4 comprising a lower suction box 6, from which air is exhausted through a pipe 8, and an upper housing 10, in which there is arranged a pair of parallel pipes 12 which are perforated and extend crosswise over the wire 2. In end walls 14 of the housing 10 are mounted rotation bearings 16 for the pipes 12, and outside the end walls 14 the ends of the neighboring pipes 12 are interconnected through respective U-pipes 18 and 20. The latter is connected with a supply pipe 22, through which an air fluidized fiber material may be blown into one of the pipes 12, whereafter the fiber material is movable in a circulation path through the pipes 12 and the U-pipes 18 and 20. The ends of the pipes 12 are provided with non-perforated sleeve members 24, which are rotatable in the bearings 16 and are drivingly connected, through driving belts 26, with a motor pulley 28 for rotating the pipes 12. In the top side of the oblong housing 10 is provided a pair of longitudinal air intake slots 30 located above the respective pipes 12 and optionally provided with adjustable valve or air guide flaps 32 (Fig. 2).

Inside each of the pipes 12 is arranged a needle cylinder 34, see also Fig. 3, which is provided with needles 36 arranged along a screw line. The cylinders 34 have outer shafts 38 projecting through rotation bearings 40 in the U-pipe 18, the shafts 38 outside these bearings being provided with pulleys 42. The cylinders 34 are mounted eccentrically in the pipes 12 such that the needles 36 sweep over the interior bottom side of the pipes 12 of a short distance therefrom.

As shown in Fig. 2, outside and adjacent the top side of the pipes 12 may be provided some blowing nozzles 44 arranged on stationary nozzle pipes 46, while internally in the pipes 12 there may be provided stationary air screens 48 stretching through the pipes near the top portions thereof.

The system so far described is known from WO 81/02031, to which reference is made for a detailed description of the operation of the system. The main function is that the blown-in and circulated fiber material is brought to be successively discharged through the perforated pipe 12 by the action of the air which, from the suction box 6, is sucked down through the housing 10 from the slots 30, this air flowing downwardly both through the perforated pipes 12 and through the areas outside these pipes, whereby the fibers discharged from the pipes will be conveyed down to be deposited on the forming wire 2 and thus, on that wire, be moved away from the forming unit in an even fiber layer on the wire. The discharge of the fibers from the perforated pipes 12 is greatly promoted by the action of the needle cylinder 34, the needles 36 of which, by the rapid rotation of the cylinder, will agitate and reorganize the fibers and even act centrifugally on the fibers. Moreover, by the screw-like arrangement of the needles on the cylinder, the cylinder will contribute to the general transportation of the fiber material through the associated pipe 12.

In the said known system the pipes 12 are made of a suitable classification screen material having small holes of a dimension of 2—5 mm in both the longitudinal and the circumferential direction of the pipes, irrespective of the holes being circular or quadratic. These holes are primarily adapted to the use of correspondingly short cellulose fibres, though as already mentioned they may well allow for a certain discharge of considerably longer fibers.

Such a discharge of long fibers, however, may be promoted partly by an increased rotational speed of the needle cylinders and partly with the use of oblong perforations (50) in the walls of the pipes 12. A rapid rotation of the needle cylinders, whereby the tip velocity of the needles 36 will be some ten times the axial velocity of the fiber material through the pipe 12, will produce a cross oriented carding effect on the fibers inside the pipe 12, but as already mentioned the fiber discharge capacity will be even very low if the

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oblong perforations (50) of the pipe 12 are correspondingly oriented in the transverse or circumferential direction of the pipe, while the capacity is surprisingly high when the oblong perforations (50) are oriented in the longitudinal direction of the pipe.

Such an orientation of the oblong perforations is shown in Fig. 3, in which it is also shown in different area sections of the tube 12 that these perforations (50) may be arranged in different patterns in the tube wall, the perforations (50) preferably being provided as punched holes in a pipe plate material; alternatively they may be constituted by correspondingly open areas in a pipe wall made of a net wire material.

For the invention it is possibly not decisive whether the oblong perforations (50) are oriented exactly in the longitudinal direction of the pipe 12, even though with such an orientation an unexpected high discharge capacity has been observed; the perforations may be slightly oblique with respect to the said longitudinal direction, though without practically approaching the circumferential direction of the pipe.

The oblong perforations will allow for long fibres to be discharged from the pipe 12 with a desired high capacity, but at the same time, of course, they will also allow for shorter fibers to be discharged. It is perfectly possible, therefore, to make use of a mixture of short and long fibers, whereby, as mentioned, products of advantageous special characteristics may be manufactured.

It is an associated problem how the pipes 12 can be supplied with a fiber material consisting of both short and long fibers. With the invention this problem is solved by providing for separate flows of air fluidized fibers originating and defibrated from respective separate pulp materials, these flows being individually fed to a mixing unit, from which the resulting flow is fed to the forming unit. This principle is schematically illustrated in Fig. 4, in which the two individual defibrators are designated 52 and 54 and the mixing unit 56. It would be possible to make use of a single defibrator handling a mixed pulp of short and long fibers, but the system as shown and described is highly advantageous in that the two separate defibrators may be individually adapted to work with respective specific pulp materials in a specialized and optimized manner with respect to both energy consumption and gentleness towards the fibers. If required, more than two defibrators may be used.

Claims

1. A dry forming system for successively laying out a layer of fibers on a moved forming wire (2), the system being of the kind which comprises a pipe (12) of a perforated classification material and means for establishing through this pipe (12) and through a return pipe system a circulating flow of an air fluidized fiber material, which is caused to be successively discharged through the perforations of the pipe (12), and means (6) for sucking air down through the forming wire (2) such that the perforated pipe (12) as located above the wire (2) is placed generally in a downwardly directed air flow, by which the fibers discharged through the perforations of the pipe (12) are carried downwardly for delivery onto the forming wire (2); inside the pipe (12) is arranged a needle cylinder (34) rotating about an axis, which is parallel with the axis of the pipe (12), but preferably located underneath this axis, such that the needles of the cylinder sweep across a longitudinal, internal area of the perforated pipe (12) at a small distance from the inner surface of the pipe (12), characterized in that the needle cylinder (34) is adapted to be rotated with a needle tip velocity which is considerably higher than the velocity of the circulating fiber flow, and that the perforated pipe (12) is provided with oblong perforations (50) oriented essentially in the longitudinal direction of the pipe (12).

2. A dry forming system according to claim 1, characterized in that the perforated pipe (12) is connected with a feeding system for both long and short fibers.

3. A dry forming system according to claim 2, characterized in that the feeding system comprises at least two separate defibrators (52, 54) and a mixing unit (56) for mixing the outlet products from said defibrators (52, 54) and for feeding the mixed product into the perforated pipe (12).

Patentansprüche

1. Trockenformungssystem zum kontinuierlichen Verteilen einer Faserschicht über ein fortbewegtes Formungsdrahtnetz (2), welches System so beschaffen ist, dass es ein Rohr (12) aus einem perforierten Klassifikationsmaterial umfasst, sowie Mittel zum Bewirken eines Umlaufstromes eines mit Luft fluidisierten Fasermaterials durch dieses Rohr (12) und durch ein Rückleitungssystem, welches Fasermaterial kontinuierlich durch die Perforationen des Rohres (12) abgezogen wird, und Mittel (6) zum Absaugen von Luft durch das Drahtnetz (2), so dass das perforierte Rohr (12), das über dem Drahtnetz (2) angeordnet ist, im allgemeinen in einem nach unten gerichteten Luftstrom angebracht ist, durch den die durch die Perforationen des Rohres (12) abgezogenen Fasern zum Niederschlagen auf das Drahtnetz (2) nach unten geführt werden, wobei innerhalb des Rohres (12) ein Nadelzylinder (34) angeordnet ist, der um eine Achse rotiert, die parallel zur Achse des Rohres (12) verläuft, aber vorzugsweise unterhalb dieser Achse liegt, so dass die Nadeln des Zylinders in einem geringen Abstand von der Innenfläche des Rohres (12) über eine Längsinnenfläche des perforierten Rohres (12) streichen, dadurch gekennzeichnet, dass der Nadelzylinder (34) dazu geeignet ist, mit einer Nadelspitzengeschwindigkeit rotiert zu werden, die wesentlich höher als die Geschwindigkeit des umlaufenden Faserstromes ist, und dass das perforierte Rohr

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(12) mit länglichen Perforationen (50) versehen ist, die sich im wesentlichen in Längsrichtung des Rohres (12) erstrecken.

2. Trockenformungssystem nach Anspruch 1, dadurch gekennzeichnet, dass das perforierte Rohr (12) mit einem Zufuhrsystem für sowohl lange als auch kurze Fasern verbunden ist.

3. Trockenformungssystem nach Anspruch 2, dadurch gekennzeichnet, dass das Zufuhrsystem mindestens zwei einzelne Defibratoren (52, 54) aufweist, sowie eine Mischeinrichtung (56) zum Mischen der aus den genannten Defibratoren (52, 54) ausgetretenen Produkte und zum Zuführen des gemischten Produktes zum perforierten Rohr (12).

Revendications

1. Un système de formage à sec pour successivement arranger une couche de fibres sur un tamis de formage déplacé (2), le système étant du type qui comprend un tuyau (12) d'un matériau de classification perforé et des moyens pour établir à travers ledit tuyau (12) et à travers un système de tuyau de retour, un flux circulant d'un matériau de fibre fluidisé à l'air, ledit matériau étant forcé d'être successivement décharge à travers les perforations du tuyau (12), et des moyens (6) pour aspirer de l'air en aval à travers le tamis de formage (2) de telle façon que le tuyau perforé (12) comme situé au-dessus du tamis (2) est placé généralement dans un courant d'air orienté vers le bas, à l'aide duquel les fibres déchargés à travers les perforations du tuyau (12) sont entraînés vers le bas pour être déchargés sur le tamis de formage (2); à l'intérieur du tuyau (12) on a ménagé un cylindre à aiguilles (34) rotatif autour d'un axe étant parallèle à l'axe du tuyau (12), mais situé de préférence au-dessous dudit axe, de telle sorte que les aiguilles du cylindre parcourent une zone longitudinale, interne du tuyau perforée (12) à une petite distance de la surface intérieure du tuyau (12), caractérisé en ce que le cylindre à aguilles (34) est fait pour rotation à une vitesse de pointe d'aiguille considérablement plus élevée qui la vitesse du courant de fibres circulant, et que le tuyau perforé (12) est muni de perforations allongées (50) orientées essentiellement direction longitudinale du tuyau (12).

2. Un système de formage à sec selon la revendication 1, caractérisé en ce que le tuyau perforé (12) est couplé à un système d'alimentation pour fibres longs fibres courts.

3. Un système de formage à sec selon la revendication 2, caractérisé en ce que le système d'alimentation comprend au moins deux défibreurs (52, 54) séparés et une unité mélangeuse (56) pour mélanger les produits de sortie desdits défibreurs (52, 54) et pour alimenter le produit mélangé dans le tuyau perforé (12).

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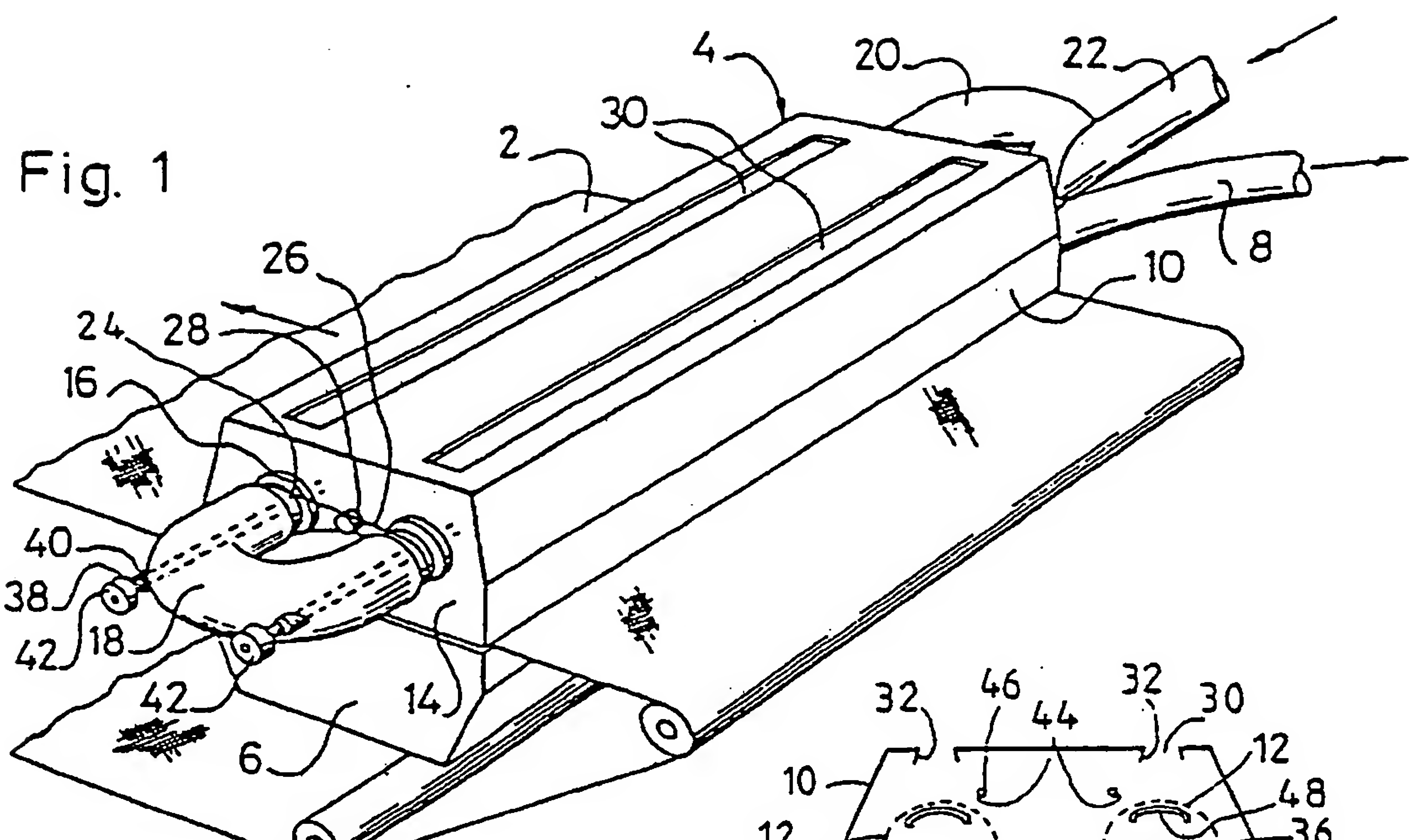

Fig. 1

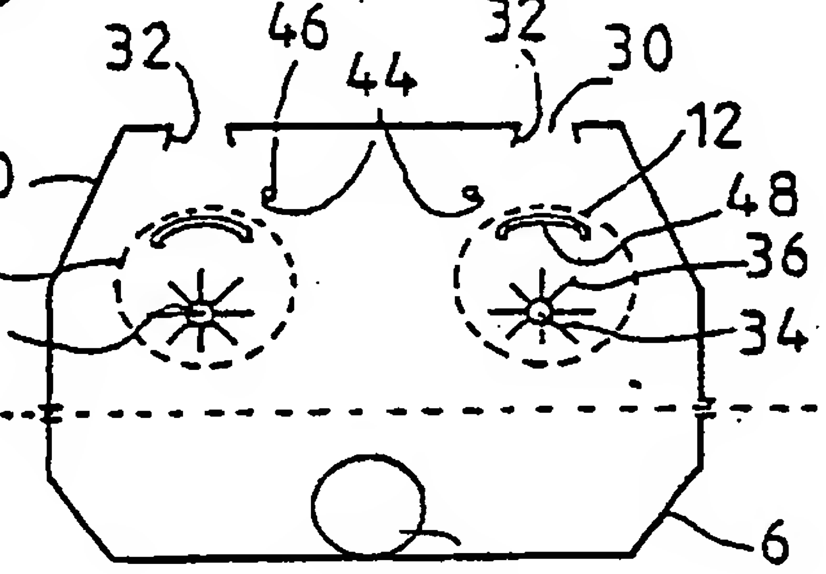

Fig. 2

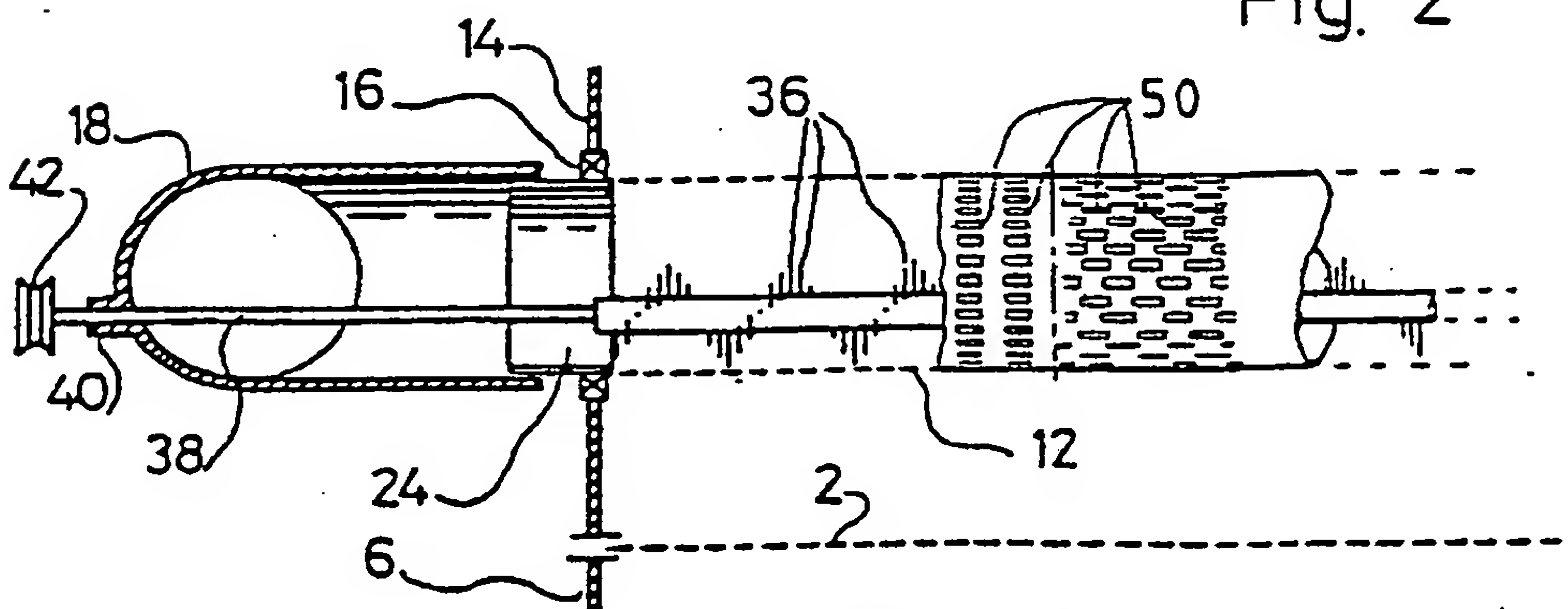

Fig. 3

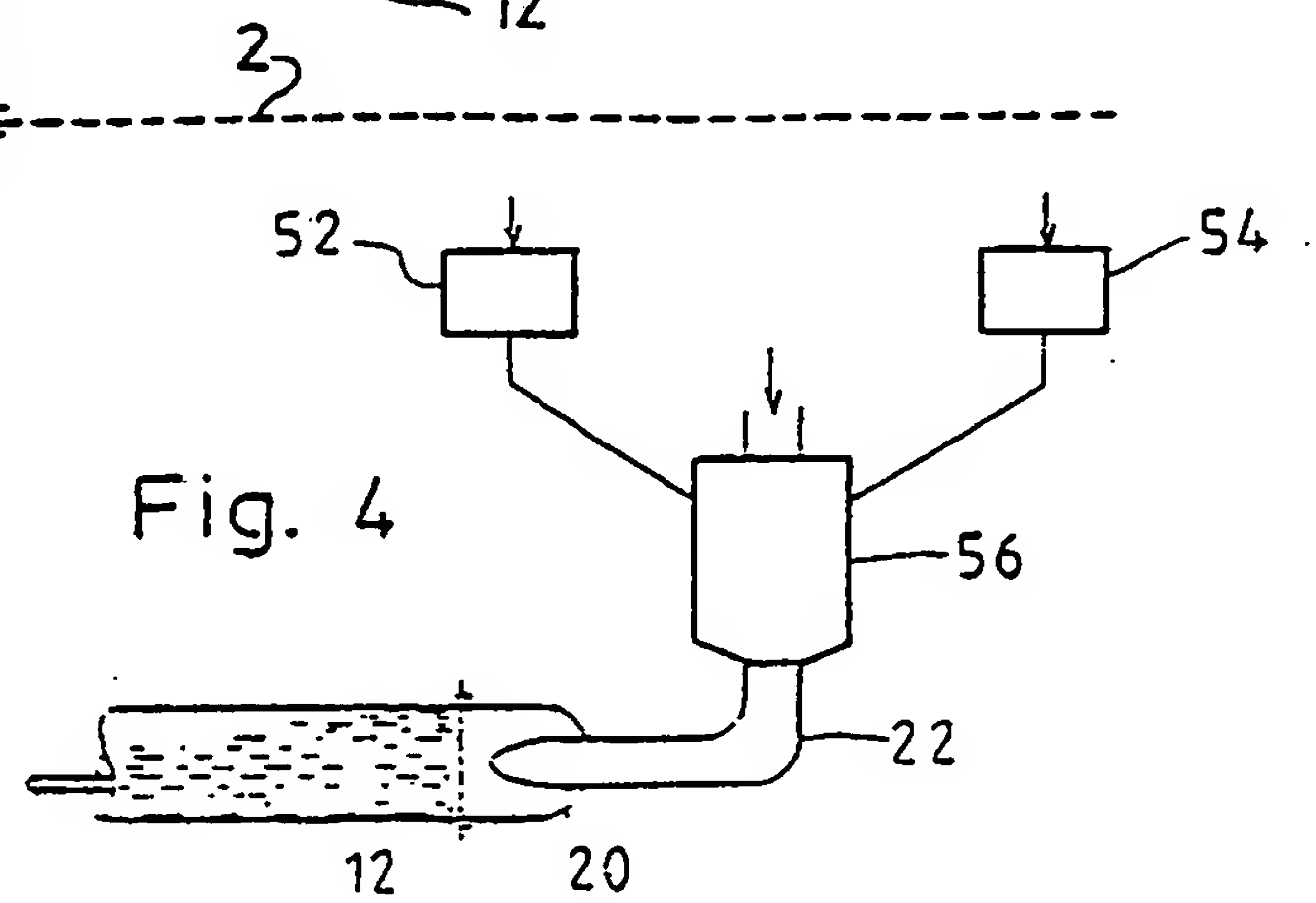

Fig. 4

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